JOURNAL OF APPLIED BEHAVIOR ANALYSIS 2011, **44,** 341–349 NUMBER 2 (SUMMER 2011)

FURTHER ANALYSIS OF PICTURE INTERFERENCE WHEN TEACHING WORD RECOGNITION TO CHILDREN WITH AUTISM

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Previous research indicates that pairing pictures with associated words when teaching sight-word reading may hinder acquisition (e.g., Didden, Prinsen, & Sigafoos, 2000; Singh & Solman, 1990; Solman & Singh, 1992). The purpose of the current study was to determine whether this phenomenon was due to a previously learned association between the spoken word and picture (i.e., blocking) or due to the mere presence of a picture as an extrastimulus prompt (i.e., overshadowing). Three participants were taught to recognize words that were presented alone or paired with pictures that the participants either could or could not identify prior to training. All participants learned the words more quickly when they were presented alone rather than with pictures, regardless of their prior learning history with respect to pictures representing the words. This finding is consistent with the phenomenon of overshadowing. Nonetheless, consistent with blocking, all participants also acquired the words presented alone more quickly if they could not identify the associated pictures prior to training. Together, these findings have important implications for using prompts when teaching skills to individuals with developmental disabilities.

Key words: blocking, extrastimulus prompts, overshadowing, picture prompts, sight-word recognition

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Research findings indicate that certain types of instructional prompts may hinder the acquisition of discriminations in children with developmental disabilities (e.g., Didden, Prinsen, & Sigafoos, 2000; Schreibman, 1975; Singh & Solman, 1990; Solman & Singh, 1992). Such an effect occurs when supplementary stimuli (e.g., pictures, gestures by the teacher) are paired with the natural antecedents. These supplementary stimuli likely gain control over responding, preventing the individual from learning to respond to the discriminative stimulus.

In Singh and Solman (1990), for example, eight individuals with moderate intellectual disabilities were taught to read printed words that were either presented alone or paired with a familiar picture that corresponded to the word. Results showed that the participants learned the words more quickly when the words were presented without pictures during the teaching sessions. The pictures, however, were less detrimental to acquisition when the experimenters enhanced the position and size of the words relative to the pictures. Didden et al. (2000) obtained similar findings and showed that the interference was less likely to occur if the size of the word was enlarged or if the picture was presented after the participant responded to the word alone (i.e., if the picture was presented as a consequence).

Although several studies have replicated this finding, the mechanism responsible for the effect is unclear. Two phenomena described in the respondent and operant conditioning literature—*blocking* and *overshadowing*—might explain why pictures hindered the acquisition of word recognition in these studies (Singh & Solman, 1990). When animals were taught to respond in the presence of one stimulus (e.g., a light) and then received discrimination training

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This study was conducted in partial fulfillment of the requirements for the first author's MS degree at the University of Houston–Clear Lake.

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doi: 10.1901/jaba.2011.44-341

with a compound stimulus that included the previously learned stimulus (e.g., a tone plus a light), the previously learned component primarily controlled responding (e.g., Johnson & Cumming, 1968; Seraganian & vom Saal, 1969). Thus, prior learning history is critical to this blocking effect. In Johnson and Cumming (1968), for example, five pigeons learned to respond when a single stimulus (a green background or a vertical line) was superimposed on the response key. Following this initial discrimination training, the pigeons received additional training with a compound stimulus (the vertical line on a green background). The majority of responding occurred to the initially trained stimulus when nonreinforced responding was later examined in the presence of each single stimulus.

The participants in Singh and Solmon (1990) and Didden et al. (2000) could already name the pictures prior to the teaching sessions. Thus, blocking may have occurred due to the previously learned association between the spoken name and the picture. That is, prior stimulus control of the picture over the spoken name could have blocked the development of stimulus control of the printed word over the spoken name when both stimuli were present during learning trials.

Alternatively, the detrimental effects of pictures on the acquisition of word recognition may have been due to overshadowing, a phenomenon that can occur in the absence of a prior learning history (e.g., Matzel, Schachtman, & Miller, 1985; Reynolds, 1961). Wilkie and Masson (1976), for example, found that pigeons taught to peck a key illuminated by a white triangle or circle on a red or green background exhibited very few responses when only the shape was presented on the key during extinction. Responding occurred almost exclusively in the presence of the color. Reed, Broomfield, McHugh, McCausland, and Leader (2009) replicated this effect when teaching children with autism to select between two picture cards, each containing a compound stimulus that consisted of two pictures (e.g., a bed and butterfly). The children received reinforcement for selecting one of the cards in response to the instruction to pick a card. When the pictures previously associated with reinforcement were presented singly with pictures previously associated with extinction, the children tended to select just one component of the prior compound stimulus.

Overshadowing may have occurred in Singh and Solomon (1990) and Didden et al. (2000) because the picture was simply a more salient stimulus than the word. In fact, results of some studies suggest that individuals with developmental disabilities have difficulties attending to complex stimuli, a characteristic of learning often called *stimulus overselectivity* (Dube & McIlvane, 1999; Lovaas, Schreibman, Koegel, & Rehm, 1971). Some authors have suggested that overselectivity can be attributed to overshadowing in some cases (e.g., McHugh & Reed, 2007). Consistent with an interpretation based on overshadowing, the participants in Singh and Solmon and Didden et al. showed improvements in performance when the printed word was modified (in size and position) to increase its salience relative to the picture.

Delineating the mechanisms responsible for this phenomenon or the conditions under which it occurs is important for developing effective instructional strategies. Thus, the purpose of this study was to evaluate whether the interference of pictures on acquisition reported in previous research was due to a previously learned association between the spoken word and picture (i.e., blocking) or to the mere presence of a picture as an extra-stimulus prompt (i.e., overshadowing).

METHOD

Participants and Setting

Three children who had been diagnosed with autism were recruited from a day-treatment program for individuals with developmental

disabilities. Children were eligible to participate if they had previously mastered at least 10 receptive identification targets when presented in a field of six or more and could recognize all letters of the alphabet and at least 10 but no more than 50 three- to five-letter sight words (as determined through an inspection of current and previous academic programming for children who attended the day-treatment program at the time of the study). Julian, a 4-year-old boy, spoke in three- to five-word sentences, had good discrimination skills, and had been receiving intensive behavior-analytic services for approximately 2 years. Becker was a 3-year-old boy who spoke in sentences of more than five words, had good discrimination skills, and had been receiving intensive behavior-analytic services for approximately 1 year. Keagan, a 9-year-old boy, spoke mostly in monosyllabic word approximations, had good discrimination skills, and had been receiving behavior-analytic services for approximately 3 years.

All sessions were conducted in classrooms at the day-treatment program. Participants were seated at one of their regularly assigned desks or tables. The number of other children and adults in the rooms varied from session to session based on student schedules and attendance. Desks or tables were cleared of all materials other than those required for the task. The therapist was seated next to or across from the child, depending on the typical teaching procedures used with the child. Teaching sessions occurred for each child during his regularly scheduled teaching time at least three times per week, no more than once per day. The therapists consisted of the first author and the child's lead therapist at the treatment facility. The first author taught the lead therapists how to implement the procedures via discussion and role play.

Materials

Stimuli were presented on cards (10.2 cm by 15.2 cm). The sight words, which appeared in the top portion of each card, were printed in Times New Roman font with a type size of 84. This type size was the largest possible, given the length of the cards. Accompanying pictures were photographs obtained primarily from the Internet, sized to fit on the bottom portion of the card. Examples of the stimuli are shown in Figure 1. In the word-only conditions, the word

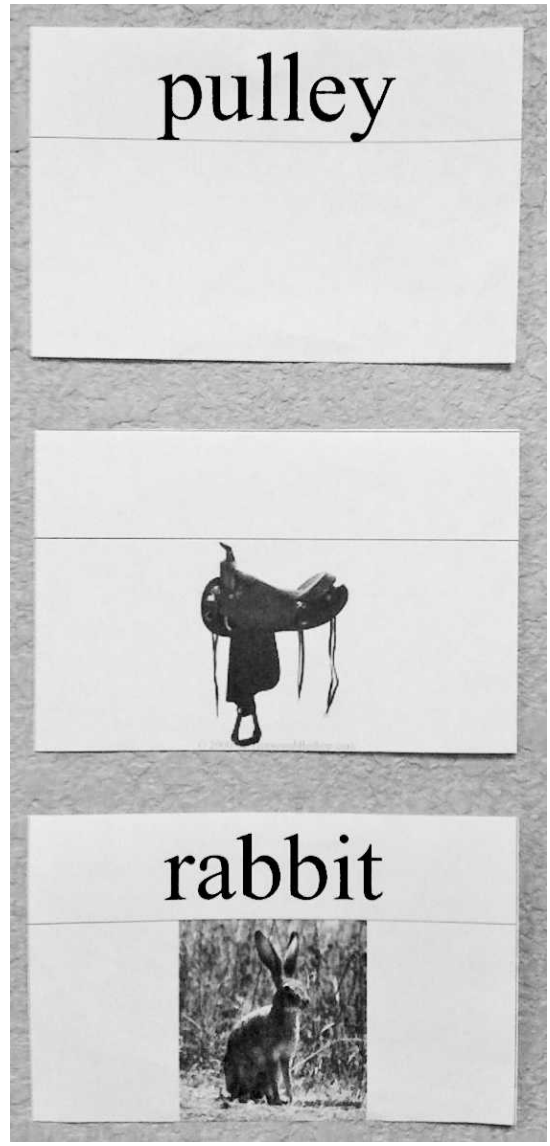

Figure 1. Example of word-only stimuli (top), picture-only stimuli (middle), and word-plus-picture stimuli (bottom).

appeared on the top of the card while the bottom of the card was blank. Conversely, in the picture-only presentations, the picture appeared on the bottom of the card and the top of the card was blank. Stimuli cards were always presented with five ''distracter'' cards. The distracter cards were from the same category as the target word, contained both words and pictures during the paired conditions (see further description below), and included at least one other word that began with the same letter as the target word.

Response Measurement and Reliability

An independent correct response was defined as the participant physically touching the stimulus that corresponded with the therapist's spoken word within 5 s of the spoken word, without any type of physical or gestural prompt. A prompted correct response consisted of the participant physically touching the stimulus that corresponded with the therapist's spoken word following either a gestural or physical prompt. During training, frequency data on independent and prompted correct responses were recorded by the therapist on a trial-by-trial basis using a data sheet designed according to the session parameters as described below. During posttest sessions, data were collected on the number of correct responses only (no prompts were delivered).

Interobserver agreement was obtained by having a second observer collect data independently during at least 34% of the training and posttest sessions. Data were compared on a trial-by-trial basis. Agreement was calculated by taking the total number of trials with exact agreement, dividing by the total number of trials, and converting to a percentage. Mean interobserver agreement for Keagan, assessed for 35% of sessions, was 99% (range, 96% to 100%). Mean interobserver agreement for Becker, assessed for 34% of sessions, was 98% (range, 94% to 100%). Mean interobserver agreement for Julian, assessed for 43% of sessions, was 99% (range, 93% to 100%).

Pretreatment Assessments

Two pretreatment assessments were conducted with each participant. A sight-word recognition assessment was conducted during which the participant was presented with an array of possible target sight words. The purpose of the assessment was to identify words that the participant could or could not identify when given the spoken name. All words consisted of six letters and two syllables. The therapist said, ''touch [target word],'' and the participant had 5 s to touch the card that displayed the correct representation. A picture-recognition assessment was also conducted during which the participant was presented with an array of pictures that corresponded with the array of possible target sight words. The therapist said, ''touch [target picture],'' and the participant had 5 s to touch the card that displayed the correct representation. For both assessments, six cards were presented at one time. The therapist delivered no prompts or reinforcement but occasionally delivered praise for compliance (i.e., sitting in the chair with hands in lap and feet on the floor; orienting towards the therapist or task materials). The first author conducted both assessments across 1 to 2 weeks during the participants' regularly scheduled instruction times until all possible targets had been presented at least once.

Printed words that the participant did not correctly identify during the sight-word assessment by touching the word when the therapist said, ''touch [target word],'' were selected as the targeted sight words or the distracters. Corresponding pictures that the participant correctly identified during the picture assessment by pointing to the picture when the therapist said, ''touch [target picture]'' were selected as the targets and distracters in the ''known'' conditions (see further description below). Pictures that the participant did not correctly identify during the picture assessment were selected as the targets and distracters for the ''unknown'' conditions. Four targets and five distracters

Table 1
Words Targeted in Each Condition

Condition	Julian	Becker	Keagan
Word only (unknown picture)	clover	bamboo	bamboo
	ginger	ginger	kidney
	possum	faucet	vortex
	thorax	saddle	rachet
Word only (known picture)	burger	carrot	basket
	castle	finger	faucet
	ladder	pickle	gasket
	pencil	waffle	pickle
Paired (unknown picture)	gasket	airbag	airbag
	lancet	gasket	lancet
	saddle	peeler	possum
	vortex	wigwam	saddle
Paired (known picture)	camper	burger	burger
	ferret	castle	ferret
	parrot	parrot	helmet
	rocket	rocket	rabbit

were selected for each condition. The targeted words and pictures identified for each participant are shown in Table 1.

Design and Conditions

A combined multielement and nonconcurrent multiple baseline design across participants was used to compare four conditions on the acquisition of sight-word recognition. In the word-only (unknown picture) condition, the therapist presented words without corresponding pictures. The participant was taught words that he did not correctly identify in the pretreatment assessment; furthermore, he did not correctly identify the corresponding pictures (i.e., no apparent prior association of the spoken words with the corresponding pictures). In the word-only (known picture) condition, the therapist also presented words without corresponding pictures. The participant was taught words that he did not correctly identify in the pretreatment assessment; however, he did correctly identify the corresponding pictures (i.e., prior association between the spoken words and the corresponding pictures). In the paired (unknown picture) condition, the therapist presented picture–word compound stimuli. Words that the participant did not correctly identify during the pretreatment assessment were combined with corresponding pictures that the participant also did not correctly identify during the assessment. In the paired (known picture) condition, the therapist presented picture–word compound stimuli. Words that the participant did not correctly identify during the pretreatment assessment were combined with corresponding pictures that the participant did correctly identify during the assessment. If the participant did not acquire a word in one or both of the paired conditions, the therapist removed the pictures in the final phase.

Procedure

Baseline. All 16 targeted sight words (i.e., the four words assigned to each condition) were randomly presented in each session. Each word was presented once, for a total of 16 trials per session. On each trial, six stimuli cards (the target and five distracters) were presented on the student's table. The therapist said, "touch [target word]," after which the student had 5 s to respond by touching one of the presented stimuli. After 5 s with no response or an incorrect response, the therapist either removed or rearranged the stimuli cards for the next trial. No prompts or reinforcement was delivered.

Training. The 16 targeted sight words were randomly presented in each session. Each word was presented five times, for a total of 80 acquisition trials per session. Words from the same condition were never presented on consecutive trials. The therapist also presented a previously mastered sight word (not a target in the study) on every fifth trial, for a total of 20 additional trials during the training sessions. The mastered sight words were included to ensure that the therapist would have opportunities to provide reinforcement for correct responses from the very beginning of training. The therapist used a three-step most-to-least prompting sequence that consisted of full physical, partial physical, and gestural prompts when teaching the targeted sight words. Each trial ended with the correct response of the

participant touching the card with the printed word that corresponded to the therapist's spoken directive. Following a correct response with a given stimulus, the subsequent trial with that stimulus began with the next least intrusive prompt. Once the gestural prompt was faded, the participant was given the opportunity to respond independently (i.e., after the verbal directive only). Each subsequent trial then began with the verbal directive only. If the participant touched an incorrect card or did not respond following the directive, the therapist reissued the statement to "touch [target word]" while providing the last successful prompt. Training for each target continued until the participant met the mastery criterion during the posttest probes (see further description below). The therapist delivered praise (e.g., "great!" or "that's right!") following each correct response for all participants. Keagan also received tokens (pennies) on a variable-ratio 5 schedule for correct responses, consistent with the reinforcement schedule used during his regular training sessions.

Posttest probe. A posttest probe was conducted immediately after each training session. Procedures were identical to those in baseline, with the exception that the therapist delivered praise if the participant emitted the correct response within 5 s. In addition, the therapist presented the picture from the paired (unknown picture) condition with six other unknown pictures and instructed the participant to "touch [target word]." The purpose was to determine if the participant could match the picture with the spoken name as the result of training. Posttest probes continued until the participant responded correctly to all targets in a given condition across three consecutive sessions.

Warm-up sessions. If a participant was absent from the treatment facility for more than 3 consecutive treatment days (due to illness, family travel, etc.), he received three warm-up training sessions prior to returning to regular teaching and posttest probe sessions. A warm-up session was identical to a regular teaching session; however, the posttest probe was not conducted, and data were not retained from these sessions. Each participant had one set of warm-up sessions. Julian had a set of warm-up sessions before Session 24 following a 6-day absence from the clinic for a family vacation. Keagan had a set of warm-up sessions before Session 26 following a 5-day absence from the clinic for surgery. Becker had a set of warm-up sessions before Session 13 following a 6-day absence from the clinic for a family vacation.

RESULTS

Figure 2 shows the number of correct targeted responses during the baseline and posttest probe sessions. (Data on responding to the pictures from the paired [unknown picture] condition are not shown.) No correct responses to the words or unknown pictures occurred during the baseline probes for any of the children. The baseline lengths were staggered by just a single data point across the three participants because of the zero levels of responding in the baseline probes and the immediate increase in correct responding during the posttest training probes. All of the participants mastered the pictures from the paired (unknown picture) condition before any of the words (in six sessions for Julian and in five sessions each for Becker and Keagan; data not shown).

Julian (Figure 2, top) mastered the words in the word-only (unknown picture) condition first (in 26 sessions) and then the words in the word-only (known picture) condition (in 35 sessions). He did not acquire the words in either of the paired conditions until the pictures were removed. After the pictures were removed, he required an additional 14 sessions to acquire the paired (unknown picture) words and an additional 17 sessions to acquire the paired (known picture) words. Like Julian, Becker (Figure 2, middle) mastered the words from the word-only (unknown picture) condition first

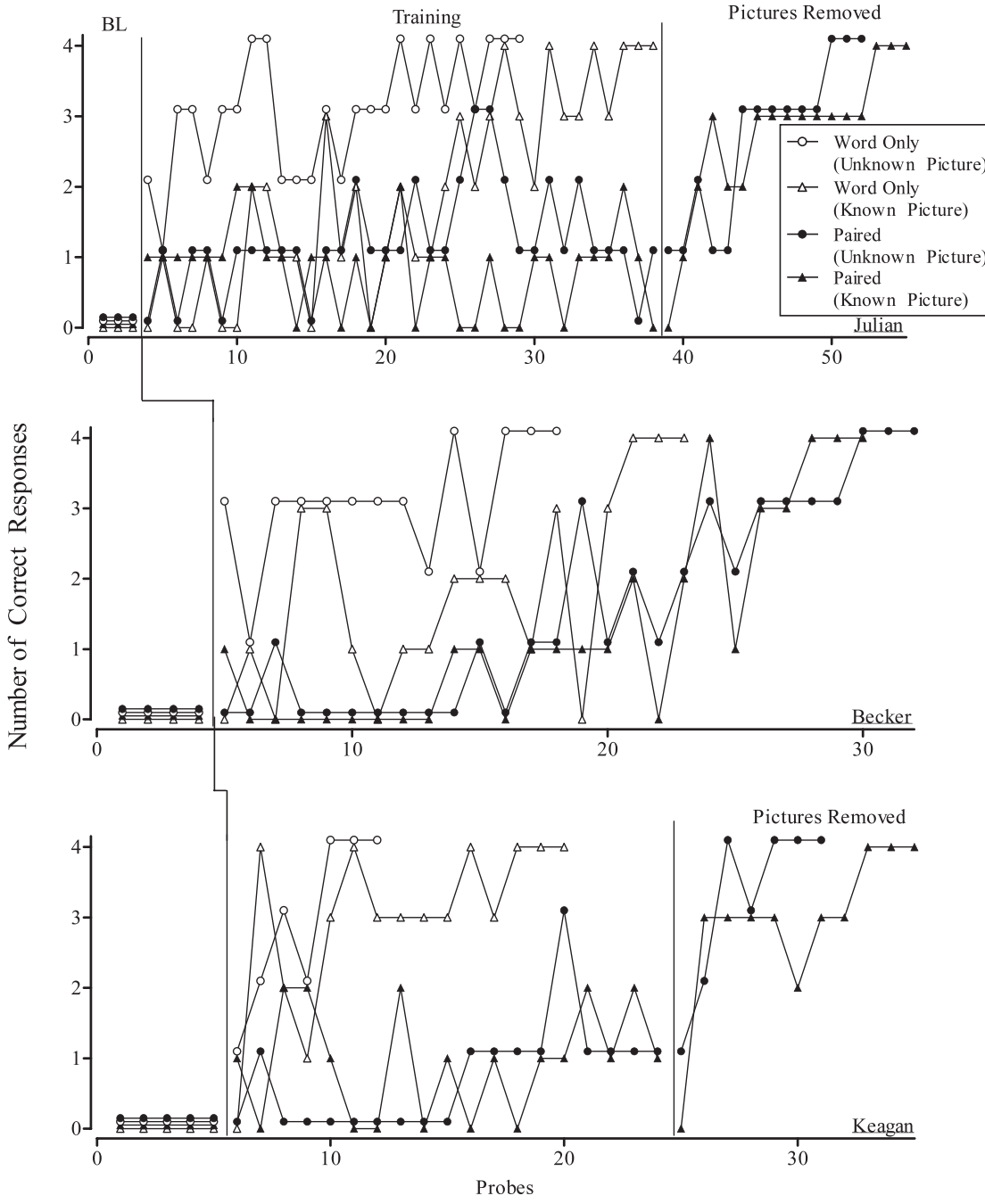

Figure 2. Number of words correctly identified during daily posttest probe sessions for the three participants.

(in 14 sessions), followed by the words from the word-only (known picture) condition (in 19 sessions). Unlike Julian, he eventually mastered the words from the paired (known and unknown picture) conditions without removal of the pictures (in 28 sessions each). The results for Keagan were similar to those for Julian. He mastered the words from the word-only

(unknown picture) condition (in seven sessions) and then the words from the word-only (known picture) condition (in 15 sessions). He did not acquire the words in either of the paired conditions until the pictures were removed. After the pictures were removed, he required an additional seven sessions to acquire the paired (known picture) words and an additional 11 sessions to acquire the paired (unknown picture) words.

DISCUSSION

These findings showed that pairing words with corresponding pictures interfered with learning, as demonstrated in previous research (Didden et al., 2000; Singh & Solman, 1990; Solman & Singh, 1992). However, this outcome occurred regardless of whether the participants could identify the pictures prior to training. That is, consistent with the phenomenon of overshadowing, a previously established association between the spoken word and picture was not necessary to hinder learning. In fact, all participants acquired the association between the spoken word and the picture prior to learning the printed word, suggesting that the picture was the more salient component of the compound stimulus. These findings are consistent with research on extrastimulus prompts and overselectivity (e.g., Schreibman, 1975).

Results also suggested that a prior association between the spoken word and its corresponding picture interfered with sight-word recognition for words presented alone during training. That is, all of the participants acquired the words from the word-only (unknown picture) condition prior to the words from the word-only (known picture) condition. This outcome is indicative of blocking. Similar differential effects were not obtained for the words paired with pictures (known vs. unknown). However, the unknown pictures quickly became known as a result of training, during which the participants were told to ''touch [target word]'' and were prompted to touch the compound stimulus that contained both the printed word and the picture it represented. All participants showed rapid acquisition of the picture portion of the stimuli when tested individually in the posttest probes, indicating that they had acquired the spoken word–picture association. Thus, it is possible that a combination of blocking and overshadowing accounted for the results obtained in the current and previous studies.

These findings, along with those from previous studies, suggest that the use of pictures does not necessarily promote word discrimination for children with autism. However, pictures as extrastimulus prompts may be advantageous if they are presented in a different manner. For example, two participants in Singh and Solman (1990) acquired words more quickly when the words were paired with pictures rather than presented alone but the size of the word was enhanced relative to the picture. This finding suggests that, for some individuals, it may be beneficial to pair words with pictures initially if the words are enlarged or the pictures are faded in some manner. Further research is needed to determine if picture prompts may actually enhance performance when combined with methods to reduce overshadowing or blocking. For example, research on overshadowing suggests that control of responding by the overshadowed stimulus (i.e., the printed word) will emerge without additional training by extinguishing the control exerted by the overshadowing stimulus (i.e., the picture; e.g., Broomfield, McHugh, & Reed, 2008; Matzel et al., 1985; McHugh & Reed, 2007; Reed et al., 2009). Introducing extrastimulus prompts after initial training with the instructional stimuli alone also may prevent overshadowing (e.g., Weiss & Panlilio, 1999). Further research is needed to determine the viability and utility of these strategies.

One limitation of this study was the use of phonetically spelled words and common nouns. It is possible that the participants gained

additional learning histories with these stimuli outside the day-treatment facility through encounters with the printed words and similar pictures in the community or at home. In future research, use of nonphonetically spelled words and nonsense pictures might provide better control over the unknown conditions. In addition, the complexity of the words may not have been appropriate for the participants' current skill levels. For example, Julian required much more training than the other participants to acquire the target words, perhaps because he did not have the prerequisite skills to discriminate among six-letter words. A final limitation is that we made no attempt to fade the pictures, a strategy that may have improved the outcomes for the paired conditions.

In conclusion, further research is needed on this common instructional strategy. Although extrastimulus prompts (e.g., pictures) may hinder acquisition under certain conditions, they may actually enhance performance when combined with methods to reduce overshadowing or blocking. Gaining a better understanding of these methods could substantially improve learning outcomes for individuals with disabilities.

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Received November 13, 2009
Final acceptance September 7, 2010
Action Editor, Joel Ringdahl